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ity had been felt by his friends lest his voice would fail to fill the theatre, for it had signally failed during the Romanes Lecture delivered in Oxford the year before, but when Huxley arose he reminded you of a venerable gladiator returning to the arena after years of absence. He raised his figure and his voice to its full height, and, with one foot turned over the edge of the step, veiled an unmistakable and vigorous protest in the most gracious and dignified speech of thanks.

Throughout the subsequent special sessions of this meeting Huxley could not appear. He gave the impression of being aged, but not infirm, and no one realized that he had spoken his last word as champion of the law of Evolution. He soon returned to Eastbourne. Early in the winter he contracted the gripe, which passed into pneumonia. He rallied once or twice, and his last effort to complete a reply to Balfour's 'Foundations of Belief' hastened his death, which came upon June 29th, at the age of seventy.

I have endeavored to show in how many ways Huxley was a model for us of the younger generation. In the central hall of the British Museum of Natural History sits in marble the life-size figure of Charles Darwin; upon his right will soon be placed a beautiful statue of Richard Owen, and I know that there are many who will enjoy taking some share in the movement to complete this group with the noble figure of Thomas Henry Huxley.

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#### ON THE CLASSIFICATION OF MUSEUMS.\*

MUSEUMS may best be classified in two ways; by the character of their contents,

\*From a paper on 'The Principles of Museum Administration,' read at the meeting of the Museums Association at Newcastle-on-Tyne, England, July 23, 1895. This portion of the paper, in modified form, was read before the Philosophical Society of Washington, January 18, 1896.

and by the purposes for which they are founded.\*

Under the first category they may be grouped as follows:

- A. Museums of Art.
- B. Historical Museums.
- C. Anthropological Museums.
- D. Natural History Museums.
- E. Technological Museums.
- F. Commercial Museums.

Under the second category they may be classed as

- G. National Museums.
- H. Local, Provincial or City Museums.
- I. College and School Museums.
- J. Professional or Class Museums.
- K. Museums or Cabinets for special research owned by societies or individuals.

#### A. Art Museums.

1. The Museum of Art is a depository for the æsthetic products of man's creative genius, such as paintings, sculptures, architecture (so far as it can be shown by models, drawings and structural fragments) and specimens of the illustrative arts (such as engravings) and illustrations of the application of art to decorative uses.

2. The greater art collections illustrate, in a manner peculiarly their own, not only the successive phases in the intellectual progress of the civilized races of man, their sentiments, passions and morals, but also their habits and customs, their dress, implements and the minor accessories of their culture often not otherwise recorded.

3. Museums of art, wherever they may be situated, have a certain general similarity to each other in purpose, contents and method of management. Those which most fully represent the art of the communities

\*In the references to special museums nothing has been further from my idea than to catalogue existing museums. Many of the most important are not even referred to by name. I have spoken only of those which are especially familiar to myself and which seem best to illustrate the idea in connection with which they are named.

to which they belong, other things being equal, are the most useful and are usually the most famous.

[Since the founding in Florence by Cosmo de' Medici, at the beginning of the sixteenth century, of the Museum of the Uffizi, perhaps the oldest museum of art now in existence, every great city in the civilized world has become the seat of a museum or gallery of art. Besides the great general collections of art, there are special museums devoted to the work of single masters, such as the Thorwaldsen Museum in Copenhagen, and the one at Brussels containing only the works of the eccentric painter, Wiertz; the Donatello Museum in the Bargello at Florence, and the Michael Angelo collections in the Florence Academy of Fine Arts and in the Casa Buonarrotti.]

#### *B. Historical Museums.*

1. The Museum of History preserves those material objects which are associated with events in the history of individuals, nations or races, or which illustrate their condition at different periods in their national life.

2. Every museum of art and every archaeological museum is also a museum of history, since it contains portraits of historical personages, pictures of historical events, and delineations of customs, costumes, architecture and race characteristics.

[Historical museums are manifold in character, and of necessity local in interest. Some relate to the histories of provinces and cities. One of the oldest and best of these is the Provincial Museum of the Mark of Brandenburg in Berlin. Of the same class are the Museum of the City of Paris in the Hotel Canavelet, and the museums of the City of Brussels and the City of Antwerp.

Others illustrate the early history of a race or country, such as the Musée Gallo-Romain at St. Germain, the Romano-German Museum at Mainz, the Etruscan Museums at Florence and Cologne, the Ghizeh Museum near Cairo, the Acropolis Museum at Athens, and the Museums in Constantinople.

Such institutions as the Bavarian National Museum at Nuremberg and the German National Museum in Munich have to do with later periods of history, and there are throughout Europe numerous collections of armor, furniture, costumes and architectural and other objects, illustrating the life and arts of the middle ages and the later periods, which are even more significant from the standpoint of the historian than from that of the artist. Important among these are the Royal Irish Academy in Dublin, and the Musée des Thermes—the 'Cluny Museum'—in Paris.

Many of the cathedrals of Europe are essentially either civic or national museums, and such edifices as Saint Paul's and Westminster Abbey belong preëminently to the latter class.

There are biographical museums, either devoted to single men—like the Galileo, Dante, and Buonarrotti Museums in Florence, or the Goethe Museum in Weimar, and the Beethoven Museum in Bonn; to the great men of a nation, as the National Portrait Gallery of Great Britain, the German Valhalla at Ratisbon, etc.; or to great men of a special profession, such as the Gallery of Artists in the Pitti Museum of Florence.

In this connection would come also collections of autographs and manuscripts (like the Dyce-Forster Collection at South Kensington), and collections of personal relics.

Midway between the Museum of History and that of Biography stands the Dynastic or Family Museum, such as the Museum of the Hohenzollerns in Berlin, and that section of the Kunsthistorisches Museum in Vienna, which illustrates the history of the Hapsburgs. The Musée Historique de Versailles is similar in its aims.]

#### *C. Anthropological Museums.*

1. The Museum of Anthropology includes such objects as illustrate the natural history of Man, his classification in races and tribes, his geographical distribution, past and present, and the origin, history and methods of his arts, industries, customs and opinions, particularly among primitive and semi-civilized peoples.

2. Museums of Anthropology and History meet on common ground in the field of

**Archæology.** In practice, Historical Archæology is usually assigned to the latter, and Prehistoric Archæology to the former. This is partly because Historic Museums, which are usually national in scope and supported on documentary evidence, treat the prehistoric races as extralimital; partly because prehistoric material is studied to best advantage through the natural history methods in use among anthropologists but not among historical students.

[Ethnographic Museums were proposed more than half a century ago by the French geographer Jomard, and the idea was first carried into effect about 1840 in the establishment of the Danish Ethnographical Museum. In Germany there are Anthropological Museums, in Berlin, Dresden and Munich, and the Museum für Völkerkunde in Leipsic; in Austria, the Court and the Oriental Museums in Vienna; in Holland, the National Ethnographical Museum in Leyden, and smaller ones in Amsterdam, Rotterdam and at The Hague; in France, the Trocadero; in Italy, the important Prehistoric and Ethnographic Museums in Rome and Florence; in Spain, the Phillippine Collections in the Museo de Ultramar in Madrid; and in Hawaii, the Bernice Pauahi Bishop Museum, at Honolulu.

In England less attention has been given to the subject than elsewhere in Europe, the Christy Collection in the British Museum, the Pitt-Rivers Collection at Oxford and the Blackmore Museum at Salisbury being the most important ones specially devoted to ethnography. In the United States, the Peabody Museum of Archæology in Cambridge, the collections in the Peabody Academy of Sciences at Salem, and the American Museum of Natural History in New York are arranged ethnographically, while the ethnological collections in the National Museum in Washington are classified on a double system, one with regard to race, the other, like the Pitt-Rivers Collection, intended to show the evolution or development of culture and civilization without regard to race. This broader plan admits much material excluded by the advocates of ethnographic museums, who devote their attention almost exclusively to the primitive or non-European peoples.

Closely related to the ethnographic museum are others devoted to some special field, such as the Musée Guimet in Paris, which is intended to illustrate the history of religious ceremonials among all races of men, a field also occupied by one department of the National Museum in Washington. Other good examples of this class are some of those in Paris, such as the Musée de Marine, which shows not only the development of the merchant and naval marines of the country, but also, by trophies and other historical souvenirs, the history of the naval battles of the Nation; and the Musée d'Artillerie, which has a rival in Madrid.

Of musical Museums, perhaps the most important are Clepissou's Musée Instrumental in Paris; that in Brussels and that in the National Museum at Washington. The collection of musical instruments at South Kensington has had its contents selected chiefly with reference to their suggestiveness in decorative art.

The Theatrical Museum at the Académie Française in Paris, the Museum of Journalism at Antwerp, the Museums of Pedagogy in Paris and St. Petersburg, are professional rather than scientific or educational, as are also the Museum of Practical Fish Culture at South Kensington, the Monetary Museum at the Paris Mint, the Museums of Hygiene in London and Washington and the United States Army Medical Museum.

The value of archæological collections, both historic and prehistoric has long been understood. The Museums of London, Paris, Berlin, Copenhagen and Rome need no comment. In the Peabody Museum in Cambridge, the American Museum in New York, the Museum of the University of Pennsylvania and the National Museum in Washington are immense collections of the remains of prehistoric man in America.]

#### *D. Natural History Museums.*

1. The Museum of Natural History is the depository for objects which illustrate the forces and phenomena of nature—the named units included within the three kingdoms, animal, vegetable and mineral,—and whatever illustrates their origin in time (or phylogeny), their individual origin, development, growth, function, structure,

and geographical distribution, past and present; also their relation to each other, and their influence upon the structure of the earth and the phenomena observed upon it!

2. Museums of Natural History and Anthropology meet on common ground in Man. In practice the former usually treats of man in his relations to other animals, the latter of man in his relations to other men.

[In most national capitals, there are general museums of natural history, in which collections representing the three kingdoms of nature are included in one group. Among the oldest and most prominent types of this class are the British Museum of Natural History in South Kensington and the Musée d'Histoire Naturelle in Paris, and there are numerous others in the great cities of both hemispheres.]

Among specialized natural history collections, a good type is the Museum of Comparative Zoölogy in Cambridge, Mass., founded by Agassiz to illustrate the history of Creation, as far as the present state of knowledge reveals the history, which was in 1887 pronounced by Alfred Russell Wallace to be far in advance of similar institutions in Europe, whether as regards the general public, the private student or the specialist.

Next in order after the Zoölogical Sections of the Museums in London and Paris, stand those of the Imperial Cabinet in Vienna; those in Berlin, Leyden, Copenhagen, Christiania, Brussels and Florence, and the La Plata Museum in Argentina, so rich in paleontological material.

The best type of the Botanical Museum is perhaps the Royal Garden at Kew, with its colossal herbarium and its special museum of economic botany, both standing in the midst of a great botanic garden. The Royal Botanical Museum in Berlin and the herbaria of the Imperial Botanical Garden in St. Petersburg are other examples.

Of specialized Geological Museums, the Imperial Cabinet in Vienna is a good type. The Museum of Practical Geology in London, founded to exhibit the collections of the Survey of the United Kingdom, and also in order to show the applications of geology to the useful processes of life, is another type of the same class.

The Department of Economic Geology in the Field Columbian Museum of Chicago, an outgrowth of the Exposition of 1893, represents this idea in the new world.

Besides the great special museums, there are the museums of local natural history, intended to show the natural history of a special region, or, it may be, to illustrate its resources in some restricted branch.

The Royal Museum of Vertebrates in Florence, devoted to the vertebrate fauna of Italy, is a type of this class, and many local museums are so prominent in some special field (such as ornithology or entomology) that their other activities attract little attention.]

#### *E. Technological or Industrial Museums.*

1. The Museum of Technology or Industrial Museum is devoted to the industrial arts and manufactures, including:

1. Materials and their sources.
2. Tools and machinery.
3. Methods and processes.
4. Products and results.
5. Waste products and undeveloped resources.

The interests here treated are thus classified:

1. Primary or exploitative industries (as Agriculture, Mining or the Fisheries.)
2. Secondary or elaborative industries (as the Textile industries, the Ceramic Industries).
3. Auxiliary industries (as Transportation).
4. Technical professions (as Engineering, War, Medicine, Engraving).

The final product of one industry (primary or secondary) may become a material or tool in another art industry or handicraft.

2. Technological Museums come into contact with others, as follows:

With the natural history museum in respect to primary materials.

With the anthropological museum in the matter of tools and processes, especially if historical and retrospective collections are undertaken.

With the art museum in regard to certain products in which a high degree of æsthetic merit has been attained.

With the commercial museum in respect to all products and materials used in commerce and manufactures.

3. There is no such thing in existence today as a general Technological Museum, conducted upon a liberal plan and doing useful educational work. The possibility of establishing such a museum remains to be demonstrated. Attempts have been made at the close of various international exhibitions, but without success.

4. It is possible that experience may show that museum work in this field can best be done in connection with Museums of Natural History and Anthropology, organizing sections of economic zoölogy in connection with zoölogical museums, economic geology and botany, respectively, with the botanical and geological collections. In this way, at least, the natural products and the crude materials could be disposed of to advantage, and the manufactured products, tools and processes, on the other hand, could be shown by the Museums of Anthropology and Art, and in connection with the Mechanical or Patent Museums; though after all a factory in actual operation is the best place to study most modern industries.

[The constantly changing interests of commerce, dependent upon changing fashions and the caprice of markets, might safely be left to the Exposition and Fair, or, if need be, cared for by commercial organizations. In the City of Philadelphia, for instance, there is a most useful permanent exhibition of objects and materials used in the construction and ornamentation of houses, kept up by the 'Building Trades Association.']

#### *F. Commercial Museums.*

1. The Commercial Museum has to do with salable crude material and manufactured articles; with markets, means of commercial distribution, prices and the demand and supply of trade.

2. It may properly be connected with the Technological Museum, but for the fact

that its purposes are likely to be more akin to those of the exposition or fair, involving a frequent renewal of exhibits in connection with commercial changes, and often certain features of competitive advertising or display on the part of private exhibitors.

3. The function of this class of museums is two-fold:

- a. To exhibit to home producers the character and location of foreign markets.
- b. To exhibit to foreign buyers the location and products of the home producer.

4. Although the usefulness of the commercial museum has not yet been fully demonstrated, it is conceivable that it might be of great service, could it be made the medium of wide international communication, and the means of a comprehensive system of exchange, through which the collections should be kept up to date and indicate the condition of the various markets of the world.

Essential to the success of such a museum would probably be a bureau of information, through which practical knowledge concerning prices, shipment and the quality of products might be obtained by manufacturers and other interested persons, and samples distributed for use in experiment and comparison.

[Examples of Commercial Museums may be found in the Musée de Melle at Ghent; that of the Chamber of Commerce at Liège, founded in 1888, and the Ottoman Commercial Museum, established in 1890 at Constantinople. These are too recent, however, to afford many lessons.]

#### *G. National Museums.*

1. National Museums contain the treasures belonging to national governments and are the legitimate successors of those treasure-houses of monarchs, princes, and ecclesiastical establishments which, until within the last two centuries, were the sole representatives of the museum idea. Every great nation now has a museum, or a group of museums more or less liberally supported,

and intimately connected with the educational undertakings of the government; often, when there are several great cities under one government, each has its own system of museums, and these together form the national system.

2. In most countries of Continental Europe the collections of the national universities form a part of the national museum system and are exceedingly efficient when thus administered.

3. National museums have opportunities which are not often shared by those under state control and their responsibilities are correspondingly great. They should occupy especially those fields which are not provided for in the other museums of the country in which they exist, and should not only refrain from competition with these museums, but afford to them unreserved coöperation.

[The principal purpose of a National Museum must be, as Prof. Jevons has well said, "the advancement of knowledge, and the preservation of specimens of works of art which hand down the history of the nation and the world." In other words, to serve as museums of record and research. It is by no means impossible, however, for them to render excellent service as educational museums, and quite independent of other considerations, they can rarely afford to sacrifice the material advantages gained from the display of popular exhibition series.

A serious obstacle to success in this direction is the vast amount of material which they all possess, and the lack of space in which to admit it. This difficulty may be partly overcome by a liberal assignment of objects to that portion of the study series which is not on exhibition.

A National Museum may not, it is true, advantageously attempt to install its separate departments in such manner as to produce the unity of effect possible in small specialized museums. This, however, is due to the fact that they are obliged to classify their material more strictly, for the attractiveness of a specialized museum grows largely from the fact that many illustrative objects are introduced into the exhibition series which are not strictly in place. The ex-

treme attractiveness of fishery exhibitions, for instance, grows from the fact that so many interesting objects only incidentally connected with the fisheries may be introduced as a setting for the objects directly related to the fisheries.

A result of the same kind is obtained in the Museum of Practical Geology in London, where a selected series of products of all the arts deriving their material from the mineral kingdom—glass, pottery, gems, metal work and many similar groups—are brought in, legitimately increasing the attractiveness of the museum to the visitor and its instructiveness to the student.

Though the great general museum cannot vie in this respect with the local museum, it has a certain advantage of another kind in its very wealth of material, for the display of vast collections, assembled from all parts of the earth and covering, it may be, many acres of floor space, strictly classified and arranged so as to show mutual relationships, affords in itself the most impressive lesson. While in smaller museums the study of individual objects may be easier, in those of the other kind there is a better opportunity for the study of great general relationships.]

#### *H. Local, Provincial or City Museums.*

1. To museums of this class belongs the duty of preserving all that which is characteristic of the region or city in which they are located. Every State or Province should have an institution of this kind to care for material illustrating its own geology, zoölogy, botany and archæology. Every city should have a historical collection for memorials of events in its history and that of its representative men.

2. It is legitimate and desirable that Local and Municipal Museums should also enter upon general museum work of a scientific and educational character. They may form collections of a general character, in order that their visitors may see and study the unfamiliar products of foreign lands, as well as those of local interest. In museums of this class, models, casts, copies and pictures of objects not actually obtainable may properly be used.

3. It is often advantageous, in small communities, for the museum and public library to be combined under one roof and one management.

*I. College and School Museums.*

1. Museums of this class are intended for the use of teachers in connection with their class-room and laboratory instruction, and to reinforce the library in the no-less-important work which it performs for the student.

2. It need scarcely be said that it is impracticable for the smaller teaching museums connected with schools and colleges to carry out the thorough specialization which is attainable in large institutions. A small collection, however scanty and imperfect it may be, is of great value not only for study purposes in connection with some school or college and for exhibition to the local public of a small town, but also as a nucleus for future development.

3. The college or school museum often becomes the local or city museum for the locality in which it is situated, and what has been said about museums of the latter class then becomes applicable to the college museum.

*J. Professional or Class Museums.*

1. Professional museums are those formed specially for the use of groups of specialists and for the education of specialists. Here belong medical, surgical and pathological museums; military and naval museums; mechanical museums (such as those connected with patent offices and the Conservatory of Arts and Manufactures in Paris); museums for special arts (like the Textile Museum connected with the Gobelin establishment, the Museum of Porcelains, in Sèvres, the Museum of Mosaics in Florence), and certain scientific museums like that of the Geological Survey of Great Britain—the Museum of Practical Geology—the Museo Psicologico in Florence, founded by Mantegazza, and many others.

2. Such institutions, usually under the control of a society, school or specialized bureau, although they may allow inspection by the public, do not necessarily undertake general educational work, but may with propriety consult first, in all matters relating to administration and display, the interests of the class for which they are formed.

*K. Private Museums or Cabinets.*

1. Such collections undertake work in only one portion of the museum field, that of fostering scientific and historical studies, and so long as they are fruitful in this direction, the manner in which they are administered concerns only the persons by whom they are controlled. It is well that there should be many museums of this kind, and that those who work in them should not be encouraged to dissipate their energies in attempting to do too much of the work which belongs to institutions of other classes, and for which these should be held responsible. These are, to all intents and purposes, scientific laboratories.

2. The private collector is of the greatest service to the public museum. He can, by the use of private wealth or individual freedom, do many things which the officers of a public museum cannot.

3. Private collectors should be encouraged for educational reasons also, for it has been frequently remarked that the men who have had in youth the training afforded by forming a collection have derived therefrom great advantage over others, even though they subsequently pursued commerce or the learned professions.

4. The private cabinet is the school in which the museum administrator forms the tastes and receives the preliminary training which fits him for his profession. There is much truth in the remark of Jevons that the best museum is that which a person forms for himself. If everyone could do this there would be less need for public



museums, but since they cannot, the person who has formed a private collection can most successfully manage one for the use of the public, since he better than anyone else is able, in considering the needs of the museum visitor, to keep in mind that saying which is so useful a guide in museum practice—'Put yourself in his place.'

G. BROWN GOODE.

#### THE X-RAYS.

HELMHOLTZ, Hertz and Kundt, the three greatest physicists of modern Germany, have died within two years, and the friends of German science feared that this loss would be followed by a standstill in physics, or at least by a lack of really important discoveries. But now we have Professor W. Röntgen's investigations in the physical laboratory of the University in Würzburg, the importance of which does not stand behind the famous electrical discoveries of Hertz in Bonn. Röntgen has found a new kind of rays—he calls them the X-rays—which, though invisible to the eye, affect the photographic plate; which produce fluorescent phenomena; which pass through wood, metal and the human body; which are neither broken by prism and lenses nor reflected.

The chief facts about the X-rays are the following: It is well known that the discharges of a large Ruhmkorff induction coil produce in a vacuum tube, such as Crookes' or Hittorf's, colored rays which go in straight lines from the cathode to the glass of the tube. These cathode rays, which have been much studied, are visible to the eye and are well characterized by the fact that the magnet changes their direction; they do not pass thick cardboard, wood, etc. The place where these cathode rays reach the glass of the tube is the centre of Röntgen's X-rays. They are not visible and are not turned aside by a magnet; in short, they are not

cathode rays, but are produced by them. If in a dark room we cover the tube by thin, black cardboard, nothing can be seen at all, even if we bring the eye in the direct neighborhood of the tube during the electric discharges. But if we now bring a card covered with barium platinocyanide near it the paper flashes up with every discharge, and this fluorescent effect is visible even if the paper is distant 2 meters from the tube, and it does not matter whether the varnished or the other side of the paper is directed towards the tube. The X-rays thus go through the black cardboard which is opaque to sunlight, and the same effect follows when a bound volume of a thousand printed pages is put between the tube and the fluorescent paper. We can measure the perviousness of the different substances to the new rays by the intensity of the light on the paper, comparing the effect with and without objects between the tube and the fluorescent surface. But there is also an objective way possible to study the perviousness, as the rays produce an effect upon photographic dry plates, which, of course, remains and allows us to control the subjective comparisons. Both methods show that wood is not much less pervious than paper; boards 3 cm. thick absorb very little. Hard rubber disks several centimeters thick do not stop the rays, and even aluminium plates 15 mm. thick do not make the fluorescence entirely disappear. Glass plates vary with the lead in them, those containing lead being less pervious. Platinum is slightly pervious, if the plate is not thicker than 0.2 mm., silver and copper can be a little thicker; lead plates 1.5 mm. thick are no longer pervious. All substances become less pervious with increasing thickness, a fact which is nicely demonstrated by photographs taken through tinfoils of gradually increasing number. The perviousness of substances of equal thickness seems chiefly dependent on the density, but